

INTERNATIONAL MONITORING STATIONS: National Interest Perspective - Technological Point of View

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ABSTRACT

The ratification of Comprehensive Test Ban Treaty (CTBT) by most of member states of the United Nations (UN) Organization proves that nuclear weapons must be eliminated worldwide. Since some countries that own nuclear weapons still do not comply with regulations, it is necessary for the UN to take action in monitoring their activities. This manuscript describes the method to conduct monitoring using radiological background information and seismic events. Combination of both information and the use of Artificial Intelligence approach should be able to provide decision about monitoring data accurately.

INTRODUCTION

Indonesia has been actively involved in International security program through United Nations Organization and other multilateral cooperations. The activities include becoming invited member of United Nations security council, international discussion on disarmament of nuclear weapons, signing the agreement of Non Proliferation Treaty (NPT), and along with other ASEAN countries declaring the nuclear weapon free zone in Southeast Asia.

These kind of involvement have been a great effort toward creating a peaceful atmosphere within the country and abroad. Currently there has been international forum, under United Nations initiative, for discussing possibility to monitor nuclear weapon testing activities of Nuclear Weapon States and to regard that their testing activities could threaten international peace. In practice, Indonesia joins other countries for developing the treaty for banning all kinds nuclear weapon testing activities (Comprehensive Test Ban Treaty). When CTBT is ratified by member states of the United Nations, these kinds of comprehensive testing, if conducted without member countries' permission, would be thought as violation to the international law and subject to sanction.

This paper will describe, from technological point of view, briefly how the nuclear weapon is built. The urgency of the need on international understanding and cooperation on banning all kinds of nuclear testing for the sake of international peaceful environment. For national interest, the need to seek possibility to take part on international monitoring system. The

methodology developed in this paper is solely taken from the author's perspective.

Principal Technology of Nuclear Weapons

Basically, nuclear-weapon program is the use of fissile material that can undergo prompt critical, which begins when the absorption of a neutron induces an atomic nucleus to divide, releasing additional neutrons ("prompt" neutrons) along with two fission-product nuclei, other radiation and considerable amount of energy. With this rapidly expanding reaction tremendous power is generated in the order of microseconds before the energy output blows the weapon apart.

Two materials that can be used for that purpose are U-235 and Pu-239. U-235, which is rare isotope of Natural Uranium, must be available in highly enriched form, at least 90 percent enriched. Most power reactors in the world use only low-enriched Uranium, namely 3 to 4 percent.

Pu-239 is made from neutron capture in the abundant isotope of Uranium, U-238, followed by double beta decay, is present only in infinitesimal quantities. Pu-239 also comes from fission in nuclear reactor. Its fission provides approximately half of the nuclear power, the rest comes from U-235. "Weapons-grade" Plutonium has been seen in US and Russia.

INTERNATIONAL MONITORING SYSTEMS

The Group of Scientific Expert (GSE) on CTBT has recommended six locations in Indonesia to be used

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as monitoring stations for weapon testing activities conducted by other countries, like French, China, United Kingdom, Russia and USA. The stations serve as detector to any seismic event which if the nuclear weapon test is underway then it is expected that the impact would be considered as one parameter of abnormal seismic activities. For instance, The nuclear testing conducted by China on Lop Nor, Xinjiang resulted approximately 5.7 on Richter scale. The stations will provide that kind of information.

One of the routine activities of the stations is to collect data relevant to the seismic activities, and define whether such state would be considered as normal event or abnormal event. The abnormal event then can, hopefully, be traced back to see whether the origin of such abnormal event is a natural phenomena, namely earthquake or man-made activity such as explosion resulting from nuclear weapon. Therefore, the monitoring stations must be able to distinguish the source of any abnormality of the event.

Two of the stations already built in 1986 are functioning (Jakarta and Parapat) have not been linked to the International Data Center (IDC). It is recommended that the linkage should be definitely installed such that the decision to determine any state of event is an integrated information based on cumulative data gathered from other stations around the world. Therefore, the decision is not partially determined.

THE BENEFIT OF HAVING MONITORING STATIONS

The monitoring stations described above will clearly benefit Indonesia in many ways. One of the ways is that by linkage to the International Monitoring System, Indonesia will have the opportunity to share data with other member countries. The data is particularly useful when used as an encryption to determine seismic states. For the technology purposes, the data shared with other monitoring stations can enhance accuracy to determine such state. As opposed to stand-alone data, the integrated information will provide better analysis and higher accuracy in predicting the origin of ambiguity when the event occurs.

As the input become varies, it will be more difficult to determine a condition, however, there are several technologies that can be used to assist in justifying an event. The concept is called the Fault-Tree and the Event-Tree Analysis. The Fault-tree Analysis is an analytical tool to determine the smallest combinations of events that will cause the main event

to occur. This tool is very helpful in determining whether the cause of ambiguity event comes from nuclear weapon test, for instance. Event-tree analysis is an analytical tool to determine if several events simultaneously occur then what kind of prime event will occur.

Combining the two analytical tools with an Expert System will enhance the accuracy and quickness in diagnosing the state of event. The Expert System is an Artificial Intelligence (AI) branch of computer information technology that is developed based on human expert interpretations. The interpretation is then programmed into the computer using AI language compiler to build the code and. If the code is used in all monitoring stations worldwide, the Expert System can further learn itself to be able to predict any state of event more accurately. The current technology that uses human logical thinking for describing physical phenomena more quantitatively is the use of Fuzzy Logic rules. The challenge is clear that quantizing human logic into computer code is something that even though is still plausible to do but many fields of technology application using the concept have proven otherwise. Thus, the six auxiliary stations when linked with IDC could be a valuable asset of information for Indonesia. The thought for networking and capability to have Internet for data access should be well considered. A lot of computational effort must be given to function the stations at full length. Also, the possibility to conduct simulations of seismic event based on real data will help the human-expert analysis far more accurate.

Another advantage is that the monitoring stations can also be used to assist in gathering information on seismic activities in the country and quickly advise people if there is any hazard nearby or soon becomes great disaster of natural cause. Having six stations in the country is adequate to give assistance to users in more accurate fashion. Using satellite communication for monitoring activities worldwide will determine the global perspective of international standard.

Since the parameters of monitoring is not only seismic event but also radiation level nearby the weapons testing site, this will enhance the validity of background radiation. This kind of information is particularly important for nuclear scientists and engineers when they conduct environmental radiation monitoring. International standard, established by International Atomic Energy Agency (IAEA), states that background radiation is approximately 400 mRad. Half of the background radiation comes from naturally occurring Radon. However, the author predicts that in

close proximity to the weapons testing site there are higher neutron radiation background level than gamma radiation level. Therefore, the ratio of neutron and gamma radiation surrounding the nuclear weapons testing site needs to be initially defined. The monitoring stations then can assist in calculating the relevant ratio.

Thus, the six stations besides used as the monitoring and exchanging information worldwide, they can be used as Research and Development Facilities and Educational purposes both for seismologist and for nuclear engineers - environmental radiation of finite and infinite plumes. Especially researches on the effort to simulate abnormal events.

THE DISADVANTAGES OF HAVING THE MONITORING STATIONS

The only disadvantage in operating the monitoring stations is financial. The cost of operation and maintenance could be quite high. Especially for operational cost, if the stations are linked up to the satellite and operate on real-time monitoring basis, the cost will be very expensive. Therefore, it should be managed that information downloading can be conducted in interval time basis, rather than continuous downloading sequence.

The maintenance of high-tech equipment will elevate the cost of labor and spare parts. This and other costs make up the overall operational and maintenance costs, which could be quite high.

HUMAN RESOURCES DEVELOPMENT

In addition to having monitoring stations in Indonesia, one variable that must be included in the short and long term operation is the human factor. This parameter plays a great role in operation, maintenance and improving the stations as the basis for R&D and real-world applications of the stations.

The Department of Nuclear Engineering at Gadjah Mada University is the one and the only one in the Nation. Therefore, the position of the department becomes unique. The Nuclear Science and Technology in Indonesia have now been emerging and developing with an excellent accord to the development of science and technology within the country.

The Department can play very important role in operating, maintaining, and developing the usage of the monitoring stations. The experts in the Department can develop their research interests by using the monitoring station equipments for real-world applications.

Because of its unique role, the Department can easily develop and revise its curriculum to suit with the National needs. At the moment, the experts in the

nuclear instrumentation in the Department can assist the mobility of the six stations. In the intermediate and long run, the assistance of other experts become essential.

The nuclear engineers with background concentration on environmental radiation and instrumentation make up a great expertise in operating and developing the usage of the monitoring stations. When this expertise is combined with expertise in geodetic, microelectronics, and geology, the powerful analysis can be given.

SUMMARY AND CONCLUSION

From technological point of view the existence of the six monitoring stations has several advantages including sharing data and information globally. The data and information are very useful for developing simulation events that, hopefully, can resemble the real event. However, seismic event monitoring system alone will not be able to determine if the cause of the occurrence the seismic event comes from nuclear explosion. The seismic data and radiological data from stations elsewhere will determine the cause of event more accurately.

The six auxiliary stations of monitoring seismic event in Indonesia should be regarded not only as the monitoring stations but also as the means for research and educational purposes that will strengthen the development of science and technology in Indonesia. The possibility to share data worldwide is very important for development of science and technology. The real data gathered from the stations and elsewhere is valuable information. If regarded as the monitoring station alone, the operational and maintenance costs will be quite expensive.

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